THE PRESENCE OF TOTAL COLIFORM AND FECAL COLIFORM IN THE PRIVATE BEACH RESORT OF SABAH

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ABSTRACT. *The research was conducted to determine the hygiene quality of private beach resort seawater in Sabah. Total coliform and fecal coliform were analyzed at five selected sampling locations at the resort located in Kota Kinabalu. Identification was done through the Membrane Filtration Method from APHA standard. The results showed that the highest concentration of total coliform has reached 105 cfu/100ml; and fecal coliform reached up to 92 cfu/100ml. This showed that total coliform and fecal coliform were presence in the private beach of the resort. However, it is still acceptable under Class IIB Malaysian Interim Water Quality Standard whereby both coliform contents were below 5000 cfu/ml for total coliform and 400 cfu/ml for fecal coliform. Thus, it can be concluded that the private beach is still in a good condition and suitable for recreational purposes. Contributing factors to the level of coliform contamination in the private beach of the resort are believed to be related due to the recreational activity and also the improper sanitation from the nearby local housing area. Therefore, to ensure the water quality of private beach is always under control, water quality monitoring should be done continuously to assure the recreational water is safe to be used by many.*

KEYWORDS. Total coliform, fecal coliform, membrane filter method, in-situ water quality parameters, water quality monitoring

INTRODUCTION

Pathogens can enter a water body via fecal contamination because of inadequately treated sewage, faulty or leaky septic systems, runoff from urban areas, boat and marine waste, combined overflows and waste from pets, farm animals and wildlife (Artz *et al*. 2002). Fecal indicator bacteria groups such as the total coliform (CF) and fecal coliform are utilized worldwide to measure health hazards in bathing and fish harvesting waters (Thomas and Mueller 1987). These are bacteria that are normally prevalent in the intestines and feces of warm-blooded animals, including wildlife, farm animals, pets and humans (Unc *et al*. 2004). Water samples at popular beach and harvesting waters are routinely tested for fecal contamination bacteria, which to identify the presence of pathogenic forms (US EPA 1986). Coliform is usually used to determine the hygiene quality of seawater environment (Ryan *et al*. 2004). Its presence and concentration can reflect the degree of pollution by domestic sewage and industrial waste water. Until now, there is no report on seawater hygiene quality especially on private beach seawater has been done in coast of Sabah. This research is significant in order to provide information on the status and situation of water quality in this area, and at the same time to avoid certain disease that may cause by contaminated of the seawater.

MATERIALS AND METHODS

There were five stations chosen for this study; Station 1, Station 2 and Station 3 which were located in Lagoon park of the resort, whereas Station 4 and Station 5 were at the resort beach area. The samples were taken from the stations to determine the difference and to see the effect of different stations on the bacterial count. The sampling process was done for four times each time sampling, and was taken on weekdays and weekends for comparisons. The method used in this identification of total coliform and fecal coliform from the coastal water was the membrane filter technique by APHA (1995) standard, which will gives a total coliform of (cfu) per 100 ml of the sample. The sample taken undergoes the membrane filter technique by the membrane filter unit which was wrapped with the aluminum foil and sterile. The membrane which was used for the filtration was placed on the MLS (Membrane Lauryl Sulphate) media culture on the Petri dish which was then put into sterile. Then, the Petri dish was incubated for approximately at the temperature of 44°C ± 0.5°C for fecal coliform analysis and 37°C±0.5°C for total coliform. After 24 hours, colonies with yellow colors were counted. Results were recorded as colony forming units (cfu) per 100 ml of sample (APHA 1995).

RESULTS AND DISCUSSIONS

Figure 1 and Figure 2 below; show the results of bacterial count on total coliform and fecal coliform obtained using APHA Membrane Filter Technique. Based on the Water Quality Standards by the Malaysian Department of Environment (DOE), none of these monitored stations fulfilled the requirement of Class I quality with total coliform <10 cfu/100ml; fecal coliform<10 cfu/100ml. However, the private beach of the resort was classified here as Class IIB with total coliform <5000 cfu/100ml; fecal coliform <100 cfu/100ml; that is suitable for recreational use with body and physical contact, but not for drinking purposes.

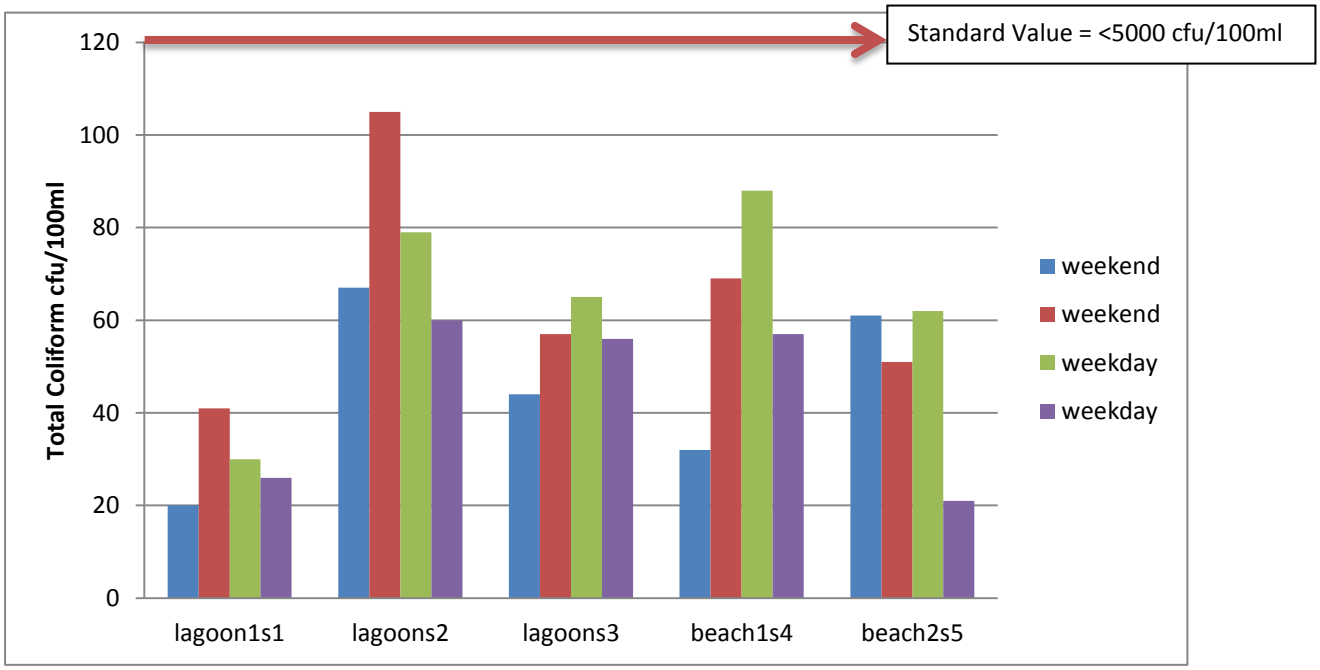

Figure 1. Total coliform at each sampling stations on weekends and weekdays.

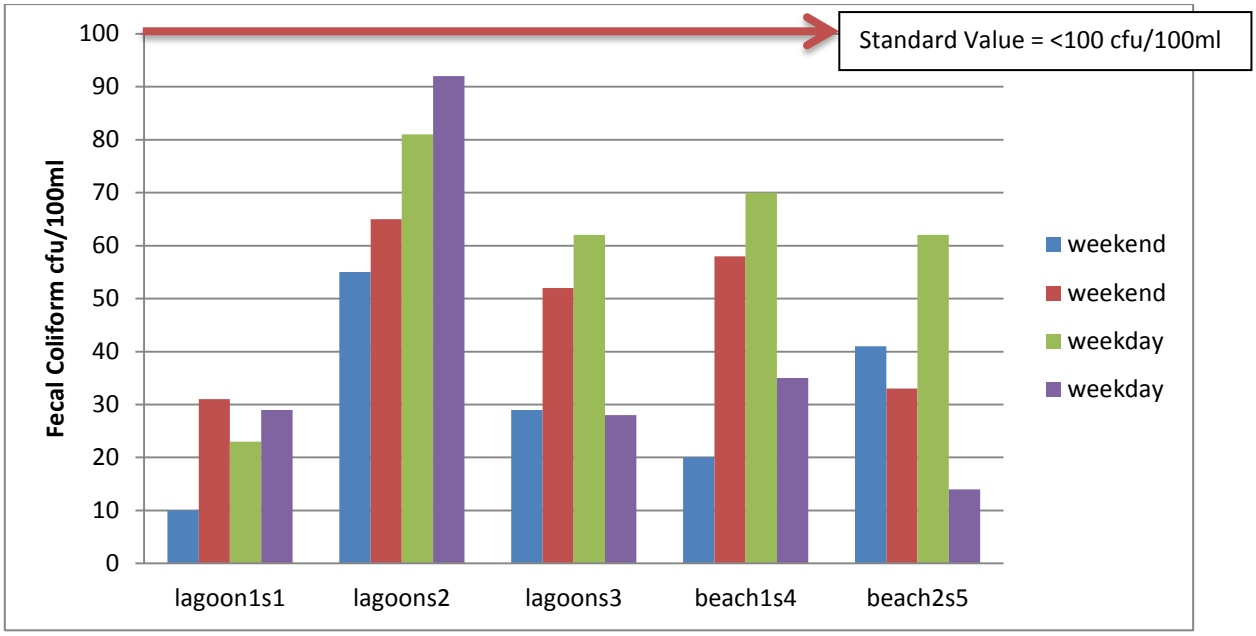

Figure 2. Fecal coliform at each sampling stations on weekends and weekdays.

From Figure 3, it shows that the highest reading of both coliforms content were obtained from Station 2 which was at the lagoon area with contaminations of 170 cfu/100ml on weekend by average value of 151 cfu/100ml coliforms and total of 604 cfu/100ml bacteria counts, followed by Station 4 beach area of the resort with 107 cfu/100ml average and total of 429 cfu/100ml bacteria counts, Station 3 lagoon site 98 cfu/100ml average, Station 5 beach site 86 cfu/100ml average and the lowest contamination recorded at Station 1 lagoon site with 50 cfu/100ml average and total of 200 cfu/100ml both coliform counts. Station 2 which was the lagoon area has the highest reading of bacterial count comparatively from all the other stations.

Based on the observation, there were more recreational activities, boating, horse riding takes place and more tourists goes for swimming activity at these area especially at Station 2. It implied that the recreational activities of the resort might greatly effect on the water hygiene quality because of both coliform counts relatively increased with the number of tourist at the resort. Study by Kaneko (1998) reported that one of the fecal coliform sources could be due to human recreational activity surround the resort. A number of bacterial, viral and other diseases can be contacted by man through exposure to sanitary-sewage-polluted bathing-water or beach sand. The increasing use of the sea for recreation has led to major concern regarding to health hazard to both local and tourist populations. A number of microbiological and epidemiological studies have been carried out since 1953 in an attempt to define the levels of risk following exposure to different concentration of bacteria in bathing waters (Saliba & Helmer, 1990). Overall the results also showed that the lagoon area of the resort is more contaminated compare to the beach site.

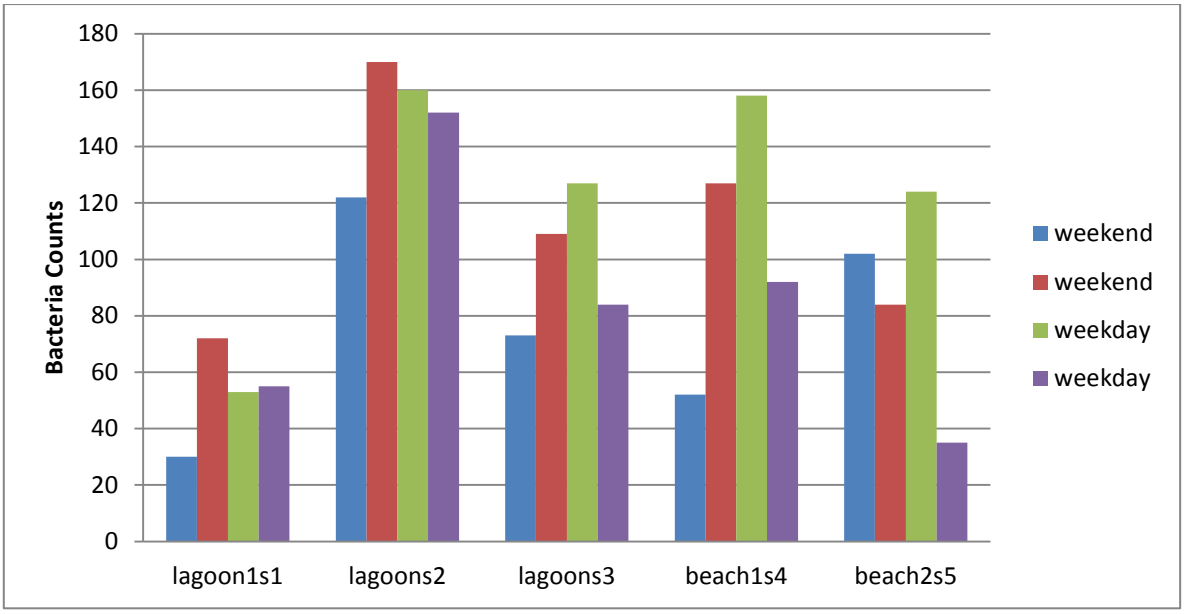

Figure 3. Bacteria counts (total coliform and fecal coliform) for each sampling sites.

One way anova test is done in this study in order to know the effect of sampling stations with the presence of coliform bacteria count. From the analysis, it was found that there are significant differences for the coliform count between the sampling stations and bacterial count where fecal coliform ($F = 4.300$; $p < 0.016$) and for total coliform ($F = 4.315$; $p < 0.016$). Therefore, this clearly shows that the sampling stations significantly have influence on the presence of the coliform bacteria count at the resort sites. It also shown in Figure 4 that the average coliform counts which were sampled on weekdays showed higher contamination with 52.0 cfu/ml average and by 52%, compare the result counts that were sampled on weekends which were 47.1 cfu/ml, by 48%. Although it was a weekdays, but the number of tourists and swimmers were high during that time as it was a school holiday terms, so the concentration of total coliform and fecal coliform may have increased rapidly at each station and affect the bacteria counts. This also may due to improper sanitation management in the nearby local housing area and sewage pipeline that connected to the private beach. Study by Crysup & Mott (2001) found that when higher number of swimmers in the beach waters it will increased the bacterial concentrations compare to lower water recreational activities.

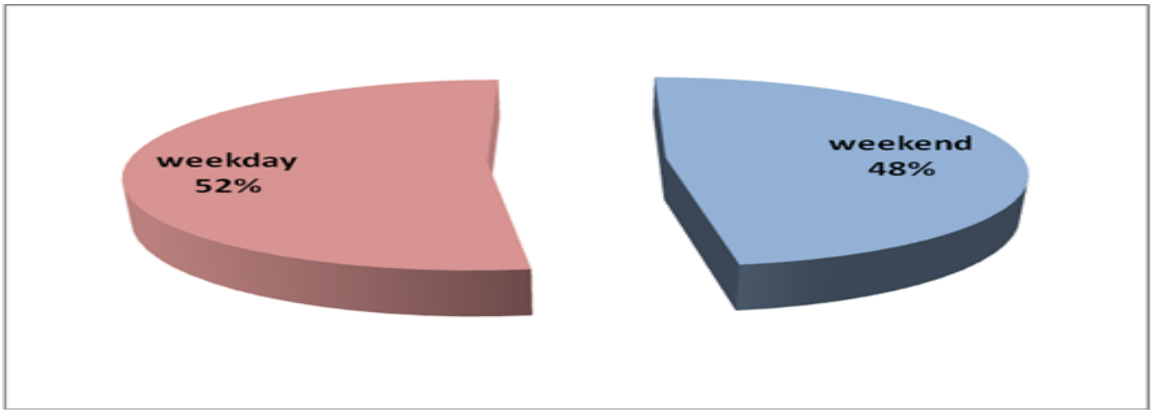

Figure 4. Bacteria counts obtained by weekends and weekdays.

CONCLUSION

It can be concluded that all the monitoring stations at the private beach of the resort are still in good condition and is suitable for recreational purposes including swimming and other direct contact with water activities under the Class IIB standard, whereby not exceeded 5000 cfu/ml for total coliform and 400 cfu/ml for fecal coliform. Regular monitoring and proper maintenance of the private beach should be introduced and applied to ensure the water quality at the private beach especially at the tourist area such as resort is always under control and precaution steps can be taken.

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